THE

Journal of the Society of Arts,

AND OF

THE INSTITUTIONS IN UNION.

111TH SESSION.] FRIDAY, OCTOBER 27, 1865. [No. 675. VOL. XIII.

TABLE OF CONTENTS.

Announcements by the Council.

INSTITUTIONS.

The following Institution has been received into Union since the last announcement:—

Gomersal (near Leeds), Mechanics' Institution.

NOTICE TO MEMBERS.

The One-Hundred-and-Twelfth Session of the Society will commence on Wednesday, the 15th November, when the Opening Address will be delivered by WM. HAWES, Esq., F.G.S., Chairman of the Council.

The following are the dates of the Wednesday evening meetings, the chair being taken at Eight o'clock:—

1865.	November	—	—	15	22	29
,,	December	6	13	20	—	
1866.	January	—	—	17	24	31
,,	February	7	14	21	28	
,,	March..........	7	14	21	—	
,,	April	4	11	18	25	
,,	May............	2	9	16	23	30
,,	June	—	—	—	27*	

For the Meetings previous to Christmas, the following arrangements have been made:—

NOVEMBER 15.—*Chairman's Opening Address.*

NOVEMBER 22.—"On Water Supply, especially in Rural Parishes and Districts." By J. BAILEY DENTON, Esq.

NOVEMBER 29.—"On the Proposed Purchase of Railways by the Government." By WILLIAM HAWES, Esq., F.G.S.

DECEMBER 6.—"On London Milk." By J. CHALMERS MORTON, Esq.

DECEMBER 13.—"On the Graphotype, a Process for producing from Drawings, Blocks for Surface Printing." By HENRY FITZ-COOK, Esq.

DECEMBER 20.—"On Parkesine, its Composition, Manufacture, and Uses. By OWEN ROWLAND, Esq.

The Cantor Lectures for the ensuing Session will consist of Three Courses, to be delivered by G. W. HASTINGS, Esq., LL.D., Barrister-at-law; FLEEMING JENKIN, Esq., F.R.S.; and Dr. F. CRACE CALVERT, F.R.S.

The following are the particulars of Mr. Hastings's course:—

LECTURE I.—MONDAY, NOVEMBER 27TH.—"The Effects of the Discovery of the Precious Metals on the Ancient Civilisation of the Mediterranean."

LECTURE II.—MONDAY, DECEMBER 4TH.—"The Effects of the Discovery of the Precious Metals on Modern Civilisation.

LECTURE III.—MONDAY, DECEMBER 11TH.—"On Copyright."

LECTURE IV.—MONDAY, DECEMBER 18TH.—"On Limited Liability."

The chair will be taken each evening at Eight o'clock.

These Lectures are open to Members, each of whom has the privilege of introducing ONE Friend to each Lecture.

* The Annual General Meeting: the Chair will be taken at Four o'clock. No Visitors are admitted to this Meeting.

Proceedings of the Society.

CANTOR LECTURES.

"ON SOME OF THE MOST IMPORTANT CHEMICAL DISCOVERIES MADE WITHIN THE LAST TWO YEARS." BY DR. F. CRACE CALVERT, F.R.S., F.C.S.

LECTURE IV.

DELIVERED ON TUESDAY, THE 25TH OF APRIL, 1865.

On some of the Discoveries in Agricultural Chemistry.

I shall in this lecture follow the same plan as I observed in my last (No. 3), taking a general view of the subject under consideration, and introducing as I proceed some of the most important discoveries which have been published of late on each particular subject. By adopting this plan I shall, on the one hand, avoid publishing a mere review of the results obtained, and on the other, I shall be enabled to give a general outline of the views entertained by most chemists of the present day on the subject of Agricultural Chemistry. You will also be better prepared to appreciate the value of the important discoveries made by our own countrymen, who, I am happy to say, are not sur-

passed in that branch of applied chemistry by any other class of chemists existing on the Continent.

The largest number of organic substances are composed of only three elements or simple bodies, viz., carbon, hydrogen, and oxygen, and even in many the latter substance is absent—for example, in many essential oils and the products resulting from the destructive distillation of organic *substances*, whilst those which contain oxygen are chiefly represented by starches, gums, resins, organic acids, and fixed oils; another class, such as morphine, quinine, and indigo, contain nitrogen, in addition to the substances mentioned. There is another class of substances, limited in number, which contain sulphur and phosphorus besides the four elements above cited; these are represented by albumen, corresponding to the white of an egg, or the serum of blood in animals; fibrine, represented in animals by the clot of blood; caseine, characterised in animals by the curd of milk. Therefore the whole of the organic matter of the vegetable kingdom is represented by the uniting together in various portions (influenced by particular molecular arrangements) of six elements, viz., carbon, hydrogen, oxygen, nitrogen, sulphur, and phosphorus.

Although organic matters are composed of two or more of these elementary substances, they are never found in vegetable matters in their pure and isolated condition. They are always combined with a certain quantity of mineral matters which appear essential to the healthy condition of plants, and are, so far as we know, essential to the formation of the organic bodies themselves. Thus chemists have ascertained that plants generally contain lime, potash, soda, magnesia, oxide of iron, sulphuric acid, phosphoric acid, &c.

Let us examine the principal sources from which plants derive the elements essential to their formation, growth, or healthy progress. The most important element of all vegetable substances, and which, in fact, characterises all organic matter, is carbon, or what is commonly called charcoal. This element is derived entirely in vegetables from a colourless, invisible, and slightly acid gas, having a specific gravity of 1·52, and also sparingly soluble in water—I mean carbonic acid. You will easily conceive, on reflection, what an enormous proportion of carbonic acid must be produced annually, when you consider the vast amount of vegetation which surrounds us, produced either by the hand of man, under the influence of the plough, and other instruments, or by the rapid growth of trees and other vegetation which covers our hills and mountains. In truth the Divine Being has provided for an abundant supply, for there exist many sources of production of this gas so necessary to vegetation. It is useless to record here the well-known modes of producing this gas by respiration and combustion, but I wish to call your attention to some more special sources of its production with which you may not be so perfectly acquainted. M. F. Kulhmann, a well-known chemist, published in 1861 and 1862 a most interesting series of papers on the production of carbonic acid through the oxidation and reduction of the oxides of iron by their contact with organic matter. Thus he found that, if he took a clod of earth, the bulk of the iron existing on its surface was in a state of peroxide, mixed with a small quantity of protoxide, whilst towards the interior of the soil the reverse was observed. M. Kulhmann thus found that the oxygen of the oxide of iron was conveyed to the organic matter to convert it into carbonic acid. He further made the remark that sulphate of lime was, as M. Chevreul had already observed, a powerful oxidising agent, or served as a conveyor of the oxygen of the atmosphere to the organic matter existing in soils, the sulphate of lime becoming converted into sulphuret of calcium. These results explain certain facts observed by two learned chemists, MM. Boussingault and Loewig, who found that there existed large quantities of carbonic acid in cultivated soils, and especially in those that were highly manured, and that the production of this gas was continuous and most abundant. The following table, taken from their researches' will satisfy you, I hope, of the correctness of the above assertion:—

Carbonic Acid.

Air	0·4
Recently manured soil	54·6
" " "	235·3
Vineyard	282·4
Forest loam	70·6
Forest land	88·2
Soil rich in manure	420·6
Meadow	161·8

Another source of the production of carbonic acid gas is one lately pointed out by a gentleman whom I cited last year with great, but not exaggerated praise, as a successful demonstrator of the untruth of the theory of spontaneous generation. M. Pasteur has demonstrated that wherever there is decay there is life—that, in fact, the rapid decay of organic matter depends in a great measure on the existence and maintenance of microscopic beings, and, as I stated in my last year's lecture, death is life. For M. Pasteur has shown that in all decaying matter exposed to the atmosphere, there exist mycoderms which carry the oxygen of the atmosphere to the organic matter, converting its carbon into carbonic acid, its hydrogen into water, its sulphur into sulphuric acid, its phosphorus into phosphoric acid. As to its nitrogen, other chemical actions come into play. There is still another source of production of carbonic acid, which I cannot pass by in silence, for though at the present day its activity is decreased by the better cultivation of land, its influence must have been very great when men were less numerous on the surface of our planet, and no doubt, even now, that source of production of carbonic acid plays a great part in the vegetation of wild forests such as those of Northern and Southern America. Dr. Lyon Playfair, Mr. J. A. Ransome, and M. Morin, proved some years since that certain small vegetable substances, known under the names of confervæ and algæ, had the property, under the influence of light, of decomposing carbonic acid; while, on the contrary, in diffused light or darkness they yield carbonic acid. Strange it is to think that often some of the trees of these wild forests carry on their surface or their bark the vegetables which are to destroy them by absorbing their sap, and to feed them by liberating the carbonic acid essential to their growth. As to the confervæ, which exist in marshy lands, pools, and other stagnant waters, they disappear by the hand of man as he drains the land and improves it for agricultural purposes. Notwithstanding the abundant sources of the production of carbonic acid, the atmosphere appears to contain but a minute quantity, viz., four parts in 10,000. This fact may be regarded as owing, first, to a law discovered by Dalton of the extraordinary property which gases have of being diffused and mingling together; secondly, to the immensity of the atmosphere as compared even with the abundant sources of carbonic acid; thirdly, to its removal by constant vegetation, either on land or in the ocean; fourthly, that a great portion of the carbonic acid which is produced in the interior of soils is absorbed by the spongelets of plants. Liebig calculated, some years since, that if our sources of production of carbonic acid were to cease, and the present state of vegetation on the surface of our planet still continued, there was a sufficient amount of carbonic acid in the atmosphere to maintain it in full activity for a great number of years. As to the decomposition of carbonic acid by the leaves of plants under the influence of the chemical rays of light—scientific points which have engaged the attention of many chemists, among whom I may cite Boussingault, Dr. Gladstone, Grinwenden, and others, it is unnecessary that I should do more than state that the carbon of the carbonic acid is retained by the plant and contributes to produce the organic matters which form the frame of it, whilst the oxygen is liberated in a pure state to contribute again to the reproduction of

carbonic acid by fixing itself on the carbon of decaying matter, or that which is produced by combustion or animal respiration.

NITROGEN.—The absorption and fixation of nitrogen in plants are of the highest importance to vegetation, and no subject has more engaged the attention of chemists and agriculturists than the ascertaining how nitrogen was supplied to plants, for if the quantity of nitrogen is found but in small quantities in plants, still its supply to vegetation is essential to the growth and health of those plants. The quantity of nitrogen that a plant requires is but small, but still as it is an essential element to the formation of nitrogenated substances, and as these are always found most abundant in all newly-formed vegetable matters, such as the germ from the seed or the sprout of the plant, nitrogen must be freely supplied by the agriculturist if he wishes to obtain an abundant crop.

Liebig's publications of 1841, proving the identity of the nitrogenated substances of plants, such as albumen, fibrine, caseine (legumine), with those existing in animals, and the exaggerated views entertained by Boussingault and Payen on the value of manures in accordance with the quantity of nitrogen they contain, led many chemists to investigate whether the nitrogen which plants require for the production of these nitrogenated substances was derived either from the atmosphere in its gaseous form, or from ammonia or nitric acid existing also in the atmosphere or in the soils in which the plants grew. An animated discussion, based upon a long series of researches, ensued between Boussingault and Ville, the latter contending that plants could absorb nitrogen from the atmosphere and fix it as a part of their organism; the former contending that the nitrogen contained in plants was derived either from ammonia or nitric acid. This discussion was still proceeding when Mr. Lawes and Drs. Gilbert and Pugh published, in the "Memoirs of the Chemical Society of London," 1863, such a complete and elaborate series of researches that chemists came to the conclusion that the nitrogen existing in plants was not derived from the atmosphere as nitrogen. There can be no doubt that the general tendency of scientific as well as practical investigation, as above stated, proves that it is most probably under the form of nitric acid, or more so in a state of nitrates, that nitrogen penetrates into plants, and becomes one of the essential elements of the formation of albumen, fibrine, legumine, or other nitrogenated substances which are found existing in vegetables. We shall as we proceed go more deeply into these interesting data, connected not only in a scientific point of view with agriculture, but having a most important bearing on its practical progress; and to give you here only one example of the importance of the subject under consideration, I may be allowed to cite the thousands of tons of guano, which have been imported into this country with a view of supplying to plants the nitrogen they require for active vegetation. In fact, so much importance was attached some twenty years ago to the presence, and more so to the amount, of nitrogen in a manure, that the whole of its commercial value was based upon the real amount of nitrogen it contained; and although in the present day these views have been greatly modified by the publications of Liebig, which have shown that for the healthy growth of plants certain mineral matters are essential, and if not so essential as nitrogen, are as important, still the commercial value of a manure at the present day depends, in a great measure, on the amount of nitrogenated matter which it contains; and there can be no doubt that the ardent discussions which have taken place between the chemists who were in favour of attributing the whole of the value of a manure to nitrogen, and Liebig, who denied these views, and supported, with his usual indomitable spirit, his all-exclusive mineral theory, led to the conclusion that if plants can live without the addition of manures, still that the use of them stimulates vegetation in a marked degree.

These views of Liebig were based on the fact that after he had noticed trees growing on a barren rock, he asked, whence did these trees derive the elements necessary to the formation of the organic tissues which entered into their composition. The reply was obvious—from the atmosphere. Therefore, if we give to plants the mineral elements, they can derive their organic construction from the elements existing in the atmosphere, and to substantiate those views, *he discovered in* rain water, collected in the open country, away from all sources of pollution, nitrate of ammonia, results which were confirmed by Dr. Lyon Playfair, and by the researches of Barrall, which are shown in the following table:—

RAIN WATER.—PARIS.

Nitrogen	7·939
Ammonia	2·769
Nitric acid	21·800
Chlorine	1·946
Lime	5·397
Magnesia	2·300

No doubt the views of Liebig are correct in theory, and will suffice for a slow and feeble vegetation, but will not answer the requirements of active husbandry, especially with heavy rents, and this has been demonstrated beyond all doubt by the elaborate researches pursued for years and at a great expense, by Mr. Lawes and Dr. Gilbert, who proved that if, on the one hand, an addition of a certain proportion of nitrogen is essential to vegetation, on the other a due regard must be paid to the nature and the amount of the mineral matters supplied to crops according to their peculiar requirements, as shown by the following tables:—

QUANTITY OF WHEAT ON SAME LAND 12 TO 20 YEARS.

	Bushels per Acre.
Farmyard manure	35
Unmanured	15
Super phosphate of lime	18
Salts of ammonia	22
Salts of ammonia Mixed mineral manure	38
Nitrate of soda	25
Nitrate of soda Mixed mineral manure	34

TABLE SHOWING THE EFFECT OF AMMONIA SALTS AND MIXED MINERAL MANURE.

Dressed Corn per Acre in Bushels and Pecks.

Plot.	1852.		1853.		1855.		1856.		1857.		1858.		1859.		1860.		1861.		1862.		1863.		1864.		Annual Average.				
	B.	P.	B.	P.	B.	P.	B.	P.	B.	P.	B.	P.	B.	P.	B.	P.	B.	P.	B.	P.	B.	P.	B.	P.	B.	P.			
3	13	3	5	3	21	0	17	0	14	2	19	3	18	0	18	1	12	3	11	1	16	0	17	1	15	2	...		Unmanured.
5	16	3	10	0	24	0	18	1	19	2	23	3	19	0	20	2	13	3	15	1	17	3	19	2	18	1	2	3	Mineral Manure.
17	24	3	8	2	44	0	18	0	31	0	26	1	33	2	20	2	25	1	18	2	27	3	21	1	18	3	3	1	Mineral Manure
18	14	1	19	1	23	3	33	0	16	3	40	2	21	3	32	2	15	3	32	3	18	2	46	1	32	2	17	0	& Ammonia Salts
10 A	21	3	9	3	34	1	19	3	24	0	29	0	22	3	18	3	15	0	12	3	23	0	39	0	22	2	7	0	Ammonia Salts
10 B	22	0	15	2	39	0	28	0	27	2	34	2	27	3	25	2	18	2	15	3	24	3	43	2	26	3	11	1	alone.
7	26	3	23	2	45	1	33	0	36	3	44	3	39	0	34	2	27	2	34	3	35	3	53	2	36	1	20	3	Ammonia Salts & Mineral Manure.

From these practical results, and many others which will be fonnd in the papers published by Mr. Lawes, F.R.S., and Dr. Gilbert, F.R.S, in the *Journal of the Agricultural Society of England*, 1863-4, it is evident that in this case, as in many others I could cite, extreme views always bring a medium result which time generally confirms as the correct one.

I shall have to refer more minutely to these theories as I proceed with my lecture. Let me, meanwhile, call your attention to several chemical reactions which tend to modify organic matter, and render it fit to penetrate into plants, so as to enable them to yield the nitrogen so essential to vegetation. If the conversion of nitrogen into nitric acid, under the influence of certain mineral substances, has been known by its results for a long period in what is called the nitrification in the walls of our dwellings, still the demonstration of the conversion of ammonia into nitric acid is the result of comparatively recent researches. Even at the present day on the Continent it is believed (except by scientific men) that the moon has a great influence on the production of nitre in the walls of dwellings. Now, it is not the moon which has that power, but the sun, and as both move in the same direction the influence of one must be affected by the other, for as we know from the researches of Bunsen and others, as stated in my first lecture, that the intensity of chemical rays is in ratio with the intensity of light, it follows that it is the chemical rays of the sun which affect the conversion, and not the rays of the moon. At all events it is easy to conceive how ammonia can be converted into nitric acid in the walls of our dwellings, for sulphate of lime has the power of condensing ammonia, and no doubt, as demonstrated by Kulhmann, of yielding its oxygen, thus converting its hydrogen into water, and its nitrogen into nitric acid, which in its turn destroys the sulphuret of calcium, giving birth to nitrate of lime. We all know that formerly, not only the rubbish from our dwellings was used as a means of obtaining the nitre which was required to manufacture the gunpowder used at that period, but that artificial nitre beds were prepared so as to yield the nitrate of potash required for war purposes. Even until recently, in Switzerland and Norway, the peasantry were subjected to a tax of supplying the government every year with a certain weight of nitre which those governments required for the preparation of gunpowder. Many researches have been undertaken to try and throw light on the chemical changes which take place in the conversion of the nitrogenated organic matter existing in such bodies into nitrates. The most interesting series of researches published on this subject are those due to M. Millon, which you will find in the *Comptes Rendue de l'Academie de Sciences*, 1864, in which he has shown that the production of nitre is in ratio with the quantity of vegetable matter, especially humic acid, that a soil contains, and that the most favourable land for the production of nitre is that which is called mould by gardeners. He further ascertained that if he made a mixture composed of ordinary earth, 20 parts, ashes, 4, mould, 3, the production of nitre was most active, and also that the oxygen of the air had a great influence on its production, converting the ammonia resulting from the decay of the organic matter into nitric acid.

These facts are well illustrated in the following table quoted from his researches:—

Nitrification.

		Parts.
Soil	Earth	20
	Ashes	4
	Decayed manure	3

	Quantity of Nitre.
Upper Layer	440
Middle do.	441
Bottom do.	009

From the above you will gather that in the upper part of a bed (1 metre in depth, and composed as above shown) there is far more nitre than in the lower portions of it. These researches of M. Millon threw much light on those published some years since by M. Boussingault, who ascertained the rate of proportions of nitre that existed in various qualities of soils and also the influence of manured land on the production of nitre in soils. Thus, M. Boussingault found that the quantity of nitre in non-manured land was a mere trace; in uncultivated land there were from 1 to 0·5 in 1,000 parts of soil, whilst in cultivated land, and in highly manured ground, 18 parts in 1,000. He further observed that if he manured a piece of land, after 7 days there were 12 parts of nitre per 1,000; in 17 days, 81 parts; in 15 days more 233; in 15 days more 280; and in 15 days further 260; and then the quantity decreased rapidly. M. Millon has clearly demonsrated that the substance which first absorbs, and then helps the conversion of the ammonia into nitric acid, is the one known by chemists under the name of humine or humic acid. The presence of a small quantity of nitrates and traces of nitre in uncultivated land may be due to two different sources.

First, Liebig, as we have already stated, demonstrated some years since, and his results have been confirmed by other chemists, that there always exist in the atmosphere small quantities of nitric acid, which are brought down to the soil by rain-falls.

Secondly, M. Cloez has recently demonstrated that the mere passage of purified air over porous substances is sufficient to force a small amount of air and oxygen to combine together so as to produce a small quantity of nitric acid. Further, all soils, so far as we are aware, contain organic matter, with which the soil comes into contact from time to time. The tenacity with which soils retain organic matter is very remarkable, for Uraldini has lately proved that if you treat a soil several times with strong muriatic acid, and wash the residue with water so as to remove all traces of acid, still, in that residue you will find the presence of organic matter. The following researches prove that the nature of this organic matter may be either considered as being similar to humine, as shown by M. Millon, or similar to cellulose, as shown by Verdeuil, or of a nitrogenated nature, as demonstrated by Baron Paul Thenard. The elaborate researches of this gentleman are most interesting in many points of view, and, without entering into details, allow me to state that he has extracted from decayed dung, as well as from soils, an acid which he has called fumic acid. This nitrogenated acid is insoluble in water, but freely soluble in weak ammoniacal liquors, thus facilitatiug its absorption by soils when rotten dung is laid on land as a manure. But this solubility of the fumate of ammonia soon disappears, for immediately that fumic acid comes in contact with peroxide of iron or oxide of aluminium (alumina) it forms an insoluble compound, which presents great stability, explaining at once how land manured one year can retain with tenacity the essential nitrogenated elements of the manure which it had one, two, or three years previously. What enhances the value of these recent researches is that Baron Thenard has succeeded in producing artificially the acid which he has discovered in rotten dung, and that by simply heating starch, sugar, gum, or substances existing in straw and other vegetable matters, with ammoniacal salts or nitrates, it being employed by him as a substitute for what we may conceive takes place under the slow action employed by nature to accomplish her general purposes. If Baron Liebig's views respecting the importance of adding mineral matters to exhausted soils were too exclusive, as tending to establish that it was necessary to use other vegetable and animal manures for a farmer to produce remunerative crops, still, there cannot be a doubt that he has rendered great service to the progress of agricultural chemistry by drawing the attention of scientific men to the general composition of soils, and enabling them to point out the

essential mineral substances that a soil should contain for it to claim the title of being fertile.

The most complete and elaborate researches which we possess on this intricate subject are due to one of our leading agricultural chemists, Dr. A. Voelcker, who has published in this year's *Journal of the Royal Agricultural Society of England* (p. 128), of which society he is the appointed chemist, a paper on some of the causes of the unproductiveness in soils, and the following table will give you not only an idea of the extent of his labours, but also point out the difference there is in the composition of soils, and that if in a soil there exists a great excess of one substance, as compared with others that compose it, that soil becomes unproductive:—

COMPOSITION OF UNPRODUCTIVE PEAT LAND, CLAY, CALCAREOUS, AND SANDY SOIL.

	Calcareous soil.	Sandy soil.	Clay soil.	Peaty soil.
Moisture	...	2·65	...	...
Organic matter and water	...	4·56	7·94	49·07
Oxides of iron and alumina	·780	5·93	10·95	10·88
Carbonate of lime	73·807	·39	·86	2·29
Magnesia	·825	...	·26	·75
Potash and soda	traces	·28	·39	·90
Phosphoric acid	·242	...	·10	·06
Sulphuric acid	1·546	...	·30	1·04
Silica	16·710	86·19	...	...
Insoluble silicious matter...	6·090	...	79·20	35·01
	100·000	100·00	100·00	100·00

Dr. Voelcker summed up his researches on the unproductiveness of soils in the following words:—

"Having spoken at some length of a variety of conditions which appear to me to affect the fertility of the land, my subject perhaps may be usefully brought to a close by a brief statement of what, in my opinion, the chemical analysis of soils can determine, and what it necessarily must leave undecided.

"In the first place I would remark, that the chemical analysis of soils can give very decided answers to the following questions:—

"1. Whether or not barrenness is caused by the presence of an injurious substance, such as sulphate of iron or sulphide of iron?

"2. Whether soils contain common salt, nitrates, or other soluble salts, that are useful when highly diluted, but injurious when they occur too abundantly?

"3. Whether or not barrenness is caused by the preponderance of—Organic matter, or lime, or sand, or pure clay?

"4. Whether sterility is caused by the absence or deficiency of—

"*a.* Lime.

"*b.* Phosphoric acid.

"*c.* Alkalies, especially potash.

"*d.* Or available mineral (ash-constituents) matters generally.

"5. Whether clays are fertile or barren?

"6. Whether or not clays are usefully burnt and used in that state as manure?

"7. Whether or not land will be improved by liming?

"8. Whether it is better to apply lime or marl or clay on a particular soil?

"9. Whether special manures, such as superphosphate or ammoniacal salts, can be used (of course discreetly) without permanently injuring the land, or whether the farmer should rather depend upon the liberal application of farm-yard-manure that he may restore to the land all the elements of fertility removed in the crops?

"10. What kinds of artificial manures are best suited to soils of various compositions?

"11. Whether deep-ploughing or steam-cultivation is likely to be useful as a means of developing the natural stores of plant-food in the soil?

"12. Whether the food of plants in the soil exists in an available or inert condition?"

(*To be continued.*)

Proceedings of Institutions.

MARLBOROUGH READING AND MUTUAL IMPROVEMENT SOCIETY.—The twenty-first annual report, presented at Michaelmas last, states that, although neither the number of members nor the income of the society has quite reached that of the preceding year, the balance in the treasurer's hands is about £2 more than at the corresponding period of last year. The committee having felt it their duty to limit the number of their lectures for the approaching season, have yet been enabled to make such engagements as cannot, they think, fail to meet with the approval of the members; they have also, after much consideration, determined not to issue *season* tickets, as it is believed ladies, not members of the society, who may wish to attend any of the lectures will not hesitate to take the ordinary tickets of admission. Owing to the prospect of a less sum being required for lecture purposes this year, the committee think it would be desirable to expend the sum, which it is hoped will thus be available, in a further increase of the society's library. The receipts have amounted to £169 3s. 9d., and there is a balance in hand of £26 7s. 3d.

SOUTH-EASTERN RAILWAY MECHANICS' INSTITUTION.—The report for the half-year ending 30th September last (being the thirty-sixth report), says that the present position of the Institution is highly satisfactory. There is always a diminution in the attractions of institutions of this kind during the summer months, but on this occasion, however, the falling off has not been so great as formerly. The present number of members is 215, being an increase of 30 over the corresponding period of last year. Three volumes have been added to the library during the half-year. The books have all been carefully examined, and a great number of them have been substantially rebound. The library now contains 1,403 volumes in excellent condition. Upwards of 1,000 volumes have been in circulation during the half-year; and the issues show that works of an intellectual and instructive character are occupying the attention of the members more than formerly. Two of the members were successful in the examinations of the Society of Arts, in May last, William Griffiths obtaining a first-class certificate in arithmetic, and Richard Giles a second-class certificate in the same subject. The former has, therefore, become entitled to 12s. worth of books from the Institution, and the latter to 8s. 6d. worth of books. The council would be very pleased if the members would more extensively avail themselves of these examinations. Arrangements have again been made to enable the members of this Institution to attend the whole course of lectures in connexion with the Ashford Institution, free of charge. The vocal music class was carried on successfully for the first three months of this half-year. The council recommend the formation of classes for the winter months, in arithmetic, French, mechanical drawing, vocal music, grammar, and composition; and they hope to make satisfactory arrangements for carrying them into effect. The council would also be very pleased to see the chess club revived amongst the members. The accounts show that the financial position is exceedingly gratifying. The sum of £67 11s. 9d. was realised by the excursions to Boulogne and Dover, on the 1st of September, which were so liberally granted by the directors of the South-Eastern Railway Company, in aid of the funds of the Institution. The balance-sheet shows that the receipts amounted to £129 15s. 5d., and that there is a balance in hand of £84 9s. 9d.

EXAMINATION PAPERS, 1865.

(*Concluded from page 729.*)

The following are the Examination Papers set in the various subjects at the Society's Final Examinations, held in April, 1865:—

GEOMETRICAL DRAWING.

THREE HOURS ALLOWED.

The constructions must be accurate, and show clearly, by plain and dotted lines, with appropriate letters of reference, the principles on which they are based. They may be put in ink or left in pencil, at the discretion of the candidate, provided they are distinct.

No deviation from the conditions of the questions can be admitted; and since no candidate must answer more than one question from any one section, he is advised not to attempt more than the time will admit of his completing, since little or no credit will be given for incomplete or inaccurate answers.

I.

Divide a line 3·75 inches long—

1. Into two segments, so that the rectangle contained by them may be 2 inches in *area*.
2. Into two segments, such that the squares described on them may be as 3 : 2.
3. Into three segments, such that the rectangle contained by the whole line and the less segment may be equal to that contained by the other two.

II.

Construct a triangle from one of the following conditions—

1. Its sides as 3 : 3·5 : 4 and their sum 8 inches.
2. Its sides in that ratio, and its area 4 inches.
3. Its base 2·5 inches, its sides equal, and the angles at the base double that at the vertex.

III.

1. The sides of a rectangle are 2 and 3 inches; construct an equilateral triangle equal to it in area.
2. Construct a regular pentagon of 2 inches side, and a regular hexagon equal to it in area.
3. Inscribe a square in a hexagon of 2 inches side.

IV.

1. Two indefinite lines contain an angle of 50°, draw a circle of 1 inch radius to touch both.
2. A point is 1 inch from the circumference of a circle of 2 inches radius, draw a line from the point to cut the circle so that the intercepted chord be 2 inches long.
3. Draw a chord in a circle of 2 inches radius, so that the angle in the greater segment cut off by it may be 70°.

V.

1. Draw the *plan* of an equilateral triangle of 2·5 inches side when its corners are 1, 1·5, and 2·5 inches above the paper.
2. A square of 2·5 inches side lies in a plane inclined to the paper at an angle of 35°, and one side of the square is inclined to the paper at 20°, show it by a *plan* and *elevation*.
3. Draw the plan of the same square when two of its sides are inclined at 20° and 40° to the paper.

VI.

1. Draw a plan and elevation of a cube of 2·5 inches sides when three of its corners are 1, 2, 2·5 inches above the paper.
2. Draw the same cube when the planes of two of its faces are inclined at 35° and 70° to the paper.
3. A right prism, 3 inches long, with a pentagon of 1·25 inches side for its base, is to be represented in *plan* and *elevation* when the line joining one corner and the centre of the opposite end is vertical.

VII.

1. A sphere of 1·6 inch radius lies on the paper; represent an indefinite plane inclined at 50° touching the surface.
2. Draw the plan of the circle in which a plane having the same inclination of 50° cuts the sphere at 1 inch from its centre.
3. A right cone and a right cylinder have the same circle of 1·5 inches radius for their common base, and a height of 4 inches; determine the sections of both, made by a plane inclined at 70° to their common axis, and passing through its middle point, the true forms of the sections to be given.

VIII.

A rectangular block 4·5 inches long, 3 inches wide, and 2·25 inches high, has a prism of the same length and breadth, and 1·5 inches high, resting on its upper face; represent this solid, either—

a. By a plan and elevation on a plane equally inclined to its two vertical faces.

b. By an isometrical projection.

c. By a perspective projection, the distance of the point of sight, &c., being at pleasure.

THEORY OF MUSIC.

THREE HOURS ALLOWED.

I. Rudiments of Musical Grammar.

(*Nos.* 1 *to* 6 *must be answered on* music paper, *and in the order in which they are put.*)

1. Put time signatures to

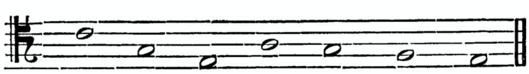
2. Write the signatures (essential sharps or flats) of *Fa* (F), *Sol* (G), *La* (A), and *Si b* (B*b*) *major;* and of *Do* (C) *Re* (D), *Mi* (E), and *Fa* (F) *minor.*

3. Transpose the following a third lower.

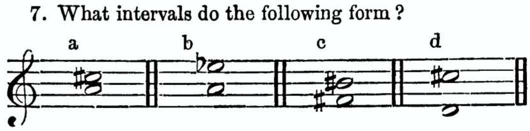
4. Write the scale of *Re* (D) *minor*, in every form with which you are acquainted.

5. Explain, by one or more examples of each, the following words:—Tetrachord, Syncopation, Augmented Second, Double Dot.

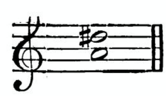
6. Write the following on the bass stave, at the same pitch.



7. What intervals do the following form?



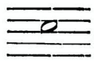
8. In what scale are these two notes?



II. Harmony, Counterpoint, and Musical History.

(*Nos.* 1 *to* 6 *to be answered on* music *paper.*)

1. Place such a clef before the following as will make it *La* (A).



2. Resolve the following dissonances.

3. Correct the following, without altering the first chord.

4. Add three parts to

5. Add a part in any kind of counterpoint above or below the following.

6. Harmonize the following.

7. State anything you know about English music and English musical composers in the seventeenth century.

FIRST WORKING MEN'S EXHIBITION AT VIENNA.

An Exhibition of this character has lately been held in Vienna. It appears, from the catalogue which has been issued, that this exhibition has been got up by certain individuals there, owing to the success which has attended such exhibitions in England.

Towards the end of last May the Minister of Commerce gave his assent to a request, made by Dr. Karl Helm, Ludwig Lobmeyr, Josef Nikola, and others, that a Working Classes Industrial Exhibition should be held in Vienna. The above-named gentlemen, with Herr Leon Mandel and others, declared themselves prepared to bear all the preliminary expenses.

On the 8th of June the programme was issued by the permission of the government. The Imperial Royal Horticultural Society lent their grounds gratuitously for the proposed purpose, and the press supported the movement in every way. Papers, descriptive of the origin and object of the exhibition, were then distributed among various Societies whose objects were the promotion of the industry of the working man, among which may be mentioned the Catholic Trade Society, the Society for the Promotion of Business among Native Jews, the Female School Society for Gratuitous Female Trade Instruction, the Female Charity Society (as regards its female trade instruction), the Imperial Royal School for the Education of the Blind, and the Home for the Maintenance of the Adult Blind. The Burgomaster lent the Common Council Chamber for the holding of a meeting, which took place on the 14th of June, at which Drs. Helm, Nikola, and Dr. Stamm gave full information relating to the holding of the exhibition. It had been the intention of the committee to give money prizes, but they ultimately decided, and stated in their programme, that for excellence in workmanship the men would receive silver medals, to be awarded by a jury of working men.

The project found support on all sides, and many persons contributed money for the purpose; and *further*, the Trades Union Society declared itself willing to co-operate in the awarding of prizes, and the like co-operation of known judges was promised, the distribution of prizes being arranged to take place at the close of the exhibition.

The following programme was issued :—

A Working Classes Industrial Exhibition, of the same character as those lately held in London, will be held in the Imperial Royal Horticultural Grounds, next the Town-park, on the occasion of the public *fêtes* in August.

1. To this exhibition will be admitted (*a*) articles useful for housekeeping, health, and daily life; (*b*) productions, models, and designs of articles which, although not of public use, are important in a scientific or artistic point of view, or which at least show the inventive genius of the exhibitor; (*c*) productions worthy of notice out of the ordinary line of the exhibitor's business.

On account of the great difficulty of making a strict and complete classification of the articles for Exhibition, they will be divided into the following heads, viz.:—

I. Objects of art.
II. Professional art work.
III. Trade productions.
IV. Female hand work.
V. Amateur work.
VI. Articles which are new in mechanism or in the application of physical or chemical science.
VII. Miscellaneous.

2. Persons desiring to exhibit must (*a*) reside in Vienna within the police radius; (*b*) belong either to the working classes, such as foremen, assistants, journeymen, handworkers, apprentices; or (*c*) be, as regards their work, amateurs; and (*d*) have made the exhibited work themselves.

3. Good workmanship will be rewarded, according to the awards of a jury of working men, by prizes (silver medals).

4. Exceptional articles, worthy of place in the Exhibition, suitable for the embellishment of the Exhibition, or affording information, as well as other objects, will be admitted, though not shown for prizes.

5. Exhibitors must bring the articles they exhibit at their own cost to the place of exhibition, and take them away on the day after its close. Articles not taken away on that day will be disposed of for the benefit of some charitable object.

6. The day of opening will be made known by special placards.

7. Allotments of space can be made until the 31st July, 1865, after which no more will be made.

The admitted articles must be brought to the place of exhibition the day before its opening, where they will be received from 8 a.m. to 7 p.m.

8. The Exhibition will be open daily from 8 a.m. to 7 p.m.

9. The price of admission will be on the opening day 30 kr. (7½d.); on other days 10 kr. (2½d.); children, half-price. All the profits will be appropriated to some useful public object.

BRITISH ASSOCIATION, 1865.

INDIA RUBBER CONSIDERED IN REFERENCE TO ITS APPLICABILITY AS AN INSULATOR FOR TELEGRAPHIC CONDUCTORS. BY WILLIAM HOOPER, ESQ.

The following paper was read in Section A, and again on the following day, in Section G, by request of that Committee:—

The difficulties which have preceded the successful issue of india rubber insulation are precisely the same which were encountered for many years after the introduction of this substance as a branch of manufacture. Native or raw india rubber, when in good condition, may be kept for years without sustaining any deterioration, but in certain stages of its manufacture it becomes susceptible of decay, which is accelerated by exposure to air and light. The decay of india rubber is now well known to be the result of oxidation, and is characterized by a gradual tendency to fluidity; its first stage of decay is recognized by a diminution of its elasticity, and by its becoming glutinous or sticky, and finally being reduced to a tarry-looking fluid, which state it always preserves.

The ultimate composition of india rubber is represented by the formula $C_8 H_7$. The analysis of Dr. Miller accords, with tolerable exactness, with this formula—he found in 100 parts 85·82 carbon and 11·11 hydrogen. The sample which he analyzed, however, contained 3·07 oxygen, and evidently could not have been pure caoutchouc. Neglecting the oxygen, the composition of pure caoutchouc, as reduced from its empirical formula ($C_8 H_7$), is 84·56 carbon, and 12·33 hydrogen, the difference in which from the results by Dr. Miller's analysis is practically nothing, and confirms the accuracy of the original analysis.

India rubber in a manufactured state contains more or less of its oxidized product, which produces the colour recognized in this substance, pure caoutchouc being colourless. The word caoutchouc should properly be applied to that pure principle of carbon and hydrogen which forms the greater part of manufactured india rubber.

The process by which india rubber is rendered suitable for the purposes of insulation, consists of an operation which involves its partial oxidation, and unless this oxidation is arrested, the india rubber becomes useless as a permanent insulator. India rubber, when thoroughly washed and dried, is masticated; by which means it becomes highly coloured, and is afterwards found to contain a variable amount of its oxidized product. By mastication, the india rubber is converted into solid masses or blocks, which are cut up into slabs or sheets; the sheets are again cut into tapes, which is the only form for applying it to telegraphic conductors. The tapes being put on the wires, another operation is required to reduce them into a perfectly uniform and solid covering; this has been usually effected either by the use of solvents or the direct application of heat, both of which plans are seriously objectionable. By the application of solvents the india rubber becomes more susceptible of oxidation, whilst the direct application of heat induces a molecular change more favourable to its oxidizing. Wires insulated by either of these means indicate a very high state of insulation when first made, but as the india rubber decays the insulation is reduced and ultimately destroyed.

About two years ago five lengths of india rubber insusulated wires were supplied to the government for submersion in the Persian Gulf, which, with the exception of one, have failed almost entirely. I was favoured with a report from government a few weeks ago, made by Mr. F. C. Webb, from which it appears that the length remaining perfect is, at the temperature of 75° Fahr., three times better than the gutta percha insulated wires which form the core of the Persian Gulf Cable. Mr. Webb stated in his report that he did not know who were the respective manufacturers of these several lengths, but he brought home a piece cut from each length for identification. On my calling upon him, he placed the several pieces before me, and I had no difficulty in recognizing my manufacture. Mr. Webb at once said that it was off the length which he had reported to the government as being the only one that remained perfect. It will be seen from these numbers that it is the highest degree of insulation yet practically attained. A length of 1,610 yards, tested under a pressure of 6,000 lbs. per square inch, and the same length, tested again under pressure of 4,480 lbs. per square inch, maintained for nearly eighty hours, showed an increase in its insulation resistance; and on removal of the pressure it was not found to have diminished, as has been stated to be the case with some specimens of india rubber insulated wire. The length under this test contained two joints. The high results obtained from joints in my insulated wires have entirely removed all apprehensions on this important point; and there is no practical limit to the age of the material in which joints can be safely and reliably made. Five miles of my insulated wire, containing in each case eight and twelve joints, were uninterruptedly maintained at the temperatures of 75° and 95° Fahr. respectively for 240 hours, and on being reduced to the initial temperature were found to have suffered no permanent change.

The facilities offered by my process for producing insulated wires of nearly identical degrees of insulation, and for reducing the most minute fault, enable me to bring forward this system as one by which absolute freedom from defects can be insured. This is a point intimately connected with the success of submarine telegraph cables; for it frequently has happened that minute faults have on submergence enlarged into sources of serious annoyance. The central position of the conductor is unaltered by any elevation of temperature; and, as it maintains a high degree of insulation at 150° Fahr., or even higher temperatures, it is peculiarly applicable for tropical seas. In its resistance to mechanical injury it far surpasses all other materials which have been tried for insulating telegraphic wires. The low inductive capacity of india rubber renders it especially suitable for telegraphic cables, and by my process the low induction of india rubber is maintained.

Sir Charles Bright, Mr. Latimer Clark, and Professor William Thomson have favoured me with the details of some very interesting investigations which they have gone through, on the qualities of my insulated wires; and, as Professor Thomson was not aware that Sir Charles Bright and Mr. Latimer Clark were giving their attention to the subject, it is highly satisfactory to find how nearly they agree in reference to the inductive capacity compared with gutta percha. Professor William Thomson found the induction of my wire as compared with that of gutta percha to be as 100 to 135, whilst Sir Charles Bright and Mr. Latimer Clark found it as 100 to 136. Mr. Wildman Whitehouse examined a length of one of my higher insulated wires, which he found as 100 to 160. As the rate of signalling is governed by the retardation arising from inductive charging, the transmission of messages will be inversely as these numbers, that is to say, that 135 to 160 messages could be sent through an Atlantic cable by using a conductor insulated with india rubber according to my process, whereas 100 only could be sent in an equal time by using a conductor insulated with gutta percha. This has a most important bearing in a financial point of view, since the cost of the insulation by my method would not be greater, and in some of its forms considerably less, than that paid for insulation by gutta percha.

(Several lengths were shown to the sections, and also a diagram illustrating the effects of temperature, as compared with gutta percha.) The mathematical properties of the curve were, for the temperatures determined on my core, similar to those obtained with gutta percha, but the differences in the insulation for increase of temperature were not so great as are observed to take place with gutta percha.

The following table gives the insulation resistances in millions of B. A. units of my core and gutta percha, at different temperatures:—

	0° Cent.	24° Cent.	38° Cent.
Gutta Percha (Persian Gulf Core)............	3205	170	45
Mr. Hooper's Core......	71036	6328	2283

A length containing a joint that had been kept in a boiling solution of salt (220° F.) for twenty hours, was placed in a vessel to be again heated to that temperature

and tested; but the committee decided that it was unnecessary to test it, or any of the specimens and joints exhibited.

The specimens and joints had been made at different periods during the last four years, and were shown for the purpose of being examined, to see that they had not suffered any change. Amongst the specimens was a length of half a mile with a joint, cut from the five miles referred to above.

During the discussion which ensued,

Mr. SIEMENS, F.R.S., expressed his concurrence with Mr. Hooper's remarks on the value of india-rubber insulation, as compared with that of gutta percha, except that india-rubber improves in insulation under pressure; with that exception he considered Mr. Hooper had kept within rather than gone beyond their relative properties. Difficulties had hitherto been found in the application of india-rubber as an insulator, and it would be interesting to the Section to know how Mr. Hooper had overcome them.

Mr. FLEEMING JENKIN, F.R.S., stated that he had for some years been acquainted with Mr. Hooper's method of insulation by india rubber, and he had never seen a length of his manufacture that indicated loss or decay. He considered the difference between the result of testing under pressure by Mr. Siemens and that by Mr. Hooper was caused by Mr. Hooper's process in consolidating the india rubber; his experience tended to confirm the statements made by Mr. Hooper. He thought it exceedingly desirable that Mr. Hooper's cable should be practically tested by being submerged and worked, as it was evident that for long lengths and tropical seas it seemed to possess very valuable properties as compared with gutta percha.

Mr. GASSIOT, F.R.S., said he thought the experiments in connection with the submergence of the two Atlantic cables had demonstrated that the two mechanical difficulties of the task could be overcome with a moderate degree of care and attention; and the most important consideration was that it had been demonstrated possible to lay a cable between Ireland and Newfoundland, but they must take care and not do as had been done in other cases, viz., lay down a cable which would only last two or three years. In this connection Mr. Gassiot pointed out the importance of the cable produced by Mr. Hooper, although he questioned if the time had arrived for a final experiment in the laying down and working of an Atlantic cable. He thought the bearing of india rubber in its various qualities as an insulator ought to be satisfactorily and conclusively determined before the laying of another cable in the Atlantic was attempted. If they went on from year to year unsuccessfully, they would absorb any amount of capital; and the citizens to whom they must go for material support would close their purses; whereas, if they only waited the result of the experiments being diligently prosecuted by electricians, they would be able to come forward with a scheme which would not only be a success, but practically with the best cable. There would then be no difficulty in raising capital, for there was no doubt that the Atlantic Telegraph would be laid; but before again embarking on the enterprise every experiment should be made. This was the only prudent and safe course to adopt. He understood the Government had sent out two or three years since several lengths of insulated wire by different manufacturers to Kurrachee, including one by Mr. Hooper, to be practically tested by submersion in the Indian seas, and a report had been lately furnished to the Government stating that all of them except the length supplied by Mr. Hooper had failed; the report to Government went on to state that Mr. Hooper's cable tested three times better than the Persian Gulf cable, which is insulated with gutta percha; the Government had, in consequence, given Mr. Hooper an order for about fifty miles of his cable, to be supplied forthwith. He considered the Atlantic Company might well follow the example set by the Government.

Fine Arts.

GRAND PRIZE OFFERED BY THE FRENCH ACADEMY OF BEAUX-ARTS.—The Academy, as trustee of the funds bequeathed by M. Bordin, has offered a prize for a subject which is peculiarly interesting when taken in connection with the coming Universal Exhibition. The theme selected is stated in the following terms:—" To examine and demonstrate the amount of influence exercised on art by circumstances, national, political, moral, religious, philosophic, and scientific. To show to what extent the most eminent artists have shown themselves independent of, or affected by such influence." The prize is, nominally, a gold medal, of the value of 2,900 francs, or £116, and the essays are to be sent in to the Secretary of the Institute on or before the 15th of June, 1867.

BUST OF RICHARD COBDEN FOR VERSAILLES.—While Mr. Woolner, the well-known English sculptor, is executing a bust of the late Richard Cobden to be presented by Mrs. Cobden to the Emperor Louis Napoleon, M. Olivia, a French sculptor, has been engaged on another bust, which is just finished, and which was ordered by the Emperor to be placed in the gallery at Versailles.

Manufactures.

AVENTURINE.—The composition of Venetian aventurine or avanturine, a vitrified substance containing specks of gold, so much used for brooches and other ornaments, remained for a long time a secret, but two chemists, M.M. Frémy and Clemandot, discovered a method of producing it. Their method was to fuse together and keep heated for twelve hours a mixture of three hundred parts of pounded glass, forty parts of protoxyde of copper, and eighty parts of oxyde of iron, and then to allow the mass to cool very gradually, and in this manner they obtained fine specimens of this artificial precious stone. M. Pelouse, another French chemist, has just communicated another method to the Academy of Sciences; he takes 250 parts of fine sand, 100 parts of carbonate of soda, 50 of carbonate of lime, and 40 parts of bichromate of potass. The glass or enamel thus obtained contains from six to seven per cent. of oxyde of chromium, of which about half is combined with the glass, while the rest remains free in the form of those brilliant metallic specks which give the peculiar character to the composition. The Parisian lapidaries who have operated on this new material, give a very favourable account of it as likely to furnish an important material to the jewellers' trade; it is said to be equal to the finest old Venetian aventurine, the metallic lustre of the enclosed specks being very brilliant, and the composition so hard that it will readily scratch and cut glass, and, consequently, is susceptible of a very high polish, and not liable to have its surface destroyed by ordinary abrasion.

SPLENDID TRIBUTE TO A MANUFACTURER IN FRANCE.—M. Carrier Belleuse, the French sculptor, who for several years was engaged in the Staffordshire Potteries, has been entrusted with the execution of an allegorical group in bronze and marble, which is to be presented to M. Henri Schneider, of the great iron works at Creusot, by the commercial and working population of the place (the subscription list containing more than nine thousand names), on the occasion of the birth of that gentleman's first child. The group is to represent Industry endowing the world with light, peace, and plenty, and the base will be decorated with three figures, representing Mining, Metallurgy, and Mechanics. The works at Creusot are, perhaps, the most important in France, and well known to all who are acquainted with engineering on the Continent. After the death of the Comte de Morny, M. G. O. Schneider performed the duties of President of the Assembly with great distinction.

Industrial and Artistic Exhibition at Bordeaux.—The Bordeaux Exhibition has more than fulfilled the expectations raised concerning it; the number of exhibitors exceeds two thousand, and the buildings are almost inconveniently crowded with objects of industry and art. Besides agricultural and industrial materials and products, the exhibition includes a retrospective museum, and is surrounded by supplementary buildings, in which a considerable number of machines are exhibited in movement. This exhibition, like all others that have taken place recently in France, shows how vast a stride has been made in that country within a few years in mechanical, agricultural, and other industries. The contents of the Bordeaux Exhibition consist principally of machinery and metal work, clock and watch work, jewellery, cabinet ware, carriages, cutlery, arms and ammunition, carpets and tissues, agricultural machinery and products, to which latter section the Imperial Government has contributed an important collection of Algerian produce. A great misfortune happened the other day to the exhibition; the rain fell in such enormous quantities and so suddenly that the drains were insufficient to carry off the flood of water, which inundated a considerable portion of the annexes. At one moment a boat might have passed along some of the main avenues of the building, and a number of visitors were obliged to seek refuge for a time on planks and other floating materials, and wait until the waters had subsided. The buildings being temporary, and of very fragile construction, there was great danger that they might give way; as it is, the mischief done to steel and other articles must be considerable.

Commerce.

The Cotton Trade.—"Amongst many other gratifying evidences of the future prosperity of the cotton trade, we notice with pleasure," say Messrs. Travers, "that the revenue arising from the cultivation of the cotton plant in Egypt bids fair to be so large as to render unnecessary the Pacha's recent negotiations for a loan of three millions. Enormous as the destruction of property must have been during the American war, and disastrous as its effect was upon us, one great advantage has certainly arisen from it, and that is, the general impetus to the cultivation of cotton in all lands where it is found practicable. America has hitherto been considered as almost the only quarter to which we should look for our principal supplies of cotton; but our daily increasing experience, stimulated, if not actually called into existence, by the painful scarcity entailed upon us by the American war, has taught us that there are very few countries within the limits of the tropics where the cotton plant may not be cultivated with ease and profit. In the course of some years we may hope to see such a state of things actually in existence; and we shall not then witness that remarkable phenomenon—our entire system of commercial finance affected to a serious extent by so unimportant a consideration as the accidental and partial deficiency of one single article of produce from one quarter of the world. The President of the Manchester Chamber of Commerce stated on a recent occasion that England was prepared to consume as much cotton as could be produced in the whole world for the next three or four years. Without entirely endorsing so strong a statement as this, we can, nevertheless, express our firm conviction that the cotton trade is destined to attain a much larger development than it has as yet achieved."

Coffee.—The following remarks on the growth and future prospects of the coffee plant, are from reports by Her Majesty's Consuls at the localities mentioned:—*Feejee.*—"Coffee has been introduced here from Tonga, and there are at present 20,000 trees in a flourishing condition; two-thirds of these will bear fruit next year. Hitherto the berries have been required for seed, as the trees so produced are found to be healthier and more productive than those imported. In the course of a few years we may hope that coffee will form an important export from the Feejee and Friendly Islands. In the latter group (Tonga) coffee trees raised from seed will bear fruit the fourth year." *Borneo.*—"Little attention has been paid to the growth of the coffee plant; from all accounts, however, the hill climate would appear to be very favourable to its growth. Coffee is largely exported from the neighbouring islands of Celebes and Java; it is, therefore, to be hoped that it will some day be exported also from this province." *Bremen.*—"The coffee trade was, compared with former years, unsatisfactory and small. Owing to bad harvests in the coffee-growing countries, prices there became too high compared with those in Europe, and the stock at Bremen during the first part of the year was so small that little or no business was done: however, after the great autumnal auctions in Holland, the coffee trade rallied a little, but never attained that importance which used to make it, next to tobacco, the principal branch of business here." *Hamburg.*—Hamburg is the largest coffee market in Europe, and supplies both the interior of Germany and the countries to the north. The quantity of coffee, of all sorts, imported last year, was 784,428 cwts. The greatest quantities were furnished by Venezuela, Brazil, and Java; but the coffee of St. Domingo, and that of Porto Rico were also in good demand. Nearly half of the coffee brought to the Hamburg market is originally imported at Altona, and transferred from thence across the frontier. Prices have been constantly rising for some years past." *Spain.*—"Coffee is an article which the Californian market will take off to a large extent. In this quarter the plantations which have been commenced are not yet in a sufficiently forward state to be able to export, but they promise well for the future."

Colonies.

Trade at Melbourne.—The official returns show that the value of the imports and exports at the port of Melbourne, from the 1st January to 19th August, 1865, as compared with the corresponding portion of the previous year were:—Imports, 1864, £9,068,738; 1865, £7,904,724. Exports, 1864, £7,521,155; 1865, £6,512,519. There is, therefore, a decrease during the present year in the value of imports of £1,124,014, and in the value of exports, £1,008,626. These figures are rather significant with respect to the operation of the new tariff, not so much as regards the consumption in the colony, but as affecting its intercolonial trade as the chief entrepôt for Australia.

Building at Melbourne.—A steady activity has recently prevailed amongst the building trades in Melbourne for several months, and the results are visible in the shape of new buildings in all or most of the main thoroughfares of the city. The erection of dwelling houses in the outskirts and suburbs of Melbourne has been carried on very extensively, and a marked improvement may be discerned in the character of the dwellings built now over that of those which were erected in earlier years; but besides, there have been a large number of buildings of importance and conspicuous appearance added to the city within the last few months.

South Australia.—The harvest of unprecedented bounty which was bestowed upon this colony in December, 1863, the high prices for which markets were found for nearly the whole of the crop, the increasing productiveness of many mines both of copper and lead, and the satisfactory state of the London wool market, combined to render the year 1864, and some portion also of 1865, a period of great prosperity to the producing interests of the colony, in which prosperity the manufacturing, commercial, and labouring classes shared naturally; but this season the profits of the mining interest must be seriously diminished by the recent fall in the value of copper, both in England and India, and the visitation of drought is of

serious interest to those concerned in pastoral pursuits, and has caused a nearly general failure of the lambing throughout the most favoured districts of the colony. The impossibility in many places of fattening stock for market, and in others of driving them there if fattened, is annoying; all these combined tend to check the growth of wool, which will seriously reduce the quantity and deteriorate the quality of this year's clip.

IMMIGRATION TO AUSTRALIA.—The influence of the gold discoveries on immigration and of immgration on wages are curiously shown by the following figures:—In 1850, 1,182 male immigrants arrived in Sydney, and wages were 4s. 6d. per diem; in 1851, the male immigrants numbered 742 (the news of the gold discovery in May not having begun to operate), and wages were 7s. 8d. upon an average of the year; in 1852, the number of male immigrants was 1,635, and the rate of wages 9s.; in 1853, 2,706 male immigrants arrived, and wages rose to 16s.; in 1854, 2,816 male immigrants arrived, and wages rose to 21s. per day; in 1855, the number of male immigrants was 5,141, and wages were 17s.; in 1856, 2,884 male immigrants arrived, and wages dropped to 13s.; in 1857, 4,415 male immigrants arrived, and wages rose to 14s.; in 1858, 2,860 male immigrants arrived, and wages dropped to 10s. 6d.; in 1859, 2,112 male immigrants arrived, and wages were still 10s. 6d.; in 1860, 1,351 male immigrants arrived, and wages were 11s.; in 1861, 794 male immigrants arrived, and wages were 11s. 6d.; in 1862, 1,172 male immigrants arrived, and wages were 10s.; in 1863, 1,966 male immigrants arrived, and wages were 10s. A variety of causes influenced the rate of wages besides the number arriving from Great Britain; but it will be seen from this analysis that the arrival of male immigrants, so far from depressing the labour of existing workmen, in some instances advanced it in a very marked degree, and can in no instance be assigned as a cause of depression.

Publications Issued.

INORGANIC CHEMISTRY FOR SCIENCE CLASSES. By Fearnside Hudson, F.C.S., F.A.S.L. (*Whitaker and Co.*) This work is intended for the use of beginners in the study of chemistry, more especially for students of science classes.

THE TANNIN PROCESS. By C. Russell. (*Robert Hardwicke.*) This is a second edition of Major Russell's original work on the dry process of photography invented by him. To this edition is added an appendix, giving the results of his later experience in its working. This process, as managed at first, had one serious fault, which rendered it less suitable for ordinary landscapes than for some other kind of subjects. The use of tannin the author considers to be attended with many advantages, and he has used his best endeavours to find a means of correcting and improving the process.

Forthcoming Publications.

THE SLIDE VALVE PRACTICALLY CONSIDERED. By N. P. Burgh, engineer. Post 8vo., cloth, with eighteen illustrations. (*E. and F. N. Spon*).—This work, which will be ready on the 1st of November, will be divided as follows:—Chap. I.—The antecedents of the Slide Valve and Steam Ports in the Cylinder. Chap. II.—The Proportion of Valves and Ports in the Cylinder, Common and Exhaust Slide Valves. Chap. III.—Equilibrium and Double-Ported Valves. Chap. IV.—The proper mode of attaining the correct amount of Lap. Chap. V.—The effect of Expansion by the action of the Slide Valve. Chap. VI.—The delineation of the Path of the Crank Pin. Chap VII.—General Observations.

Notes.

PARIS EXHIBITION OF 1867.—A perfect army of workmen is now engaged in draining and otherwise preparing the Champ de Mars for the exhibition building, a very laborious task, for the ground is not only very low, but has never been drained in any way; this preparatory work will, however, be performed in the most thorough manner, and the basement of the building will be underlaid with a thick mass of concrete, so that the character of the site will be totally changed as regards level and consequent conditions. The contract for the erection of the great outer zone or gallery of the building, in which the working machinery, and what was called in 1862 the "Process Court," will be placed, has been taken in equal shares by two of the most important firms in France, namely, MM. Gouin and Cie., and MM. Cail and Cie. This gallery forms the outer shell of the building, as may be seen by the plan published from official documents in the *Illustrated London News*, and its face will include the whole of the architectural features of the building. The inner gallery, that which surrounds the central garden, and which is to be devoted to the fine arts, will also, like the outer, be constructed in a very substantial manner; these two portions taken together form in fact the shell of the building, and will act as abutments with respect to the roof, which will cover the whole of the intervening space. The *Journal* of Charleroi, one of the principal centres of manufacture, and especially of engineering, in Belgium, says that a society has been formed at Gilly, in order to enable artizans to visit Paris and examine and report for themselves on the inventions and improvements to be found in the exhibition. The subscription is only seven pence a fortnight, and each subscribing member will have his railway ticket gratis, besides board and lodging in Paris for three days. It is said that a great number have joined the society. Similar arrangements are on foot in France.

FIRE EXTINGUISHER.—A curious apparatus called *l'Extincteur* was tested a short time since on the edge of the Seine, in Paris, and is now offered to the public. It has very much the appearance of one of those *fontaines* carried on the backs of the men who sell liquorice water in the streets of Paris, under the odd name of *Coco*, but it is in fact a soda water machine, containing, in separate compartments, solutions of a carbonate and of an acid, which remain quiescent until a stop-cock is turned, when they give rise to the production of carbonic gas, which causes the water contained in the apparatus, and which of course holds a certain amount of the gas in suspension, to flow from a jet pipe with great force.

INTERNATIONAL POSTAL ARRANGEMENTS.—Another step has been made in international postal reform by a convention passed between France and Belgium on the 12th of the present month of October, and officially announced in the *Moniteur*. By this new convention, the postage of an ordinary letter, weighing one-third of an English ounce, will be reduced from 40 to 30 centimes when prepaid, and from 60 to 50 centimes when sent unpaid; the postage of newspapers and periodical works, from ten to six centimes for 40 grammes, or $1\frac{1}{3}$ of an ounce, while other printed matter will only be liable to a tax of five centimes, or one half-penny, for the same weight; the postage of documents and business papers will be reduced to 50 centimes per 200 grammes; post-office orders will be granted for sums not exceeding 200 francs. The time when the new regulations are to come into operation is net yet published. The effect of the convention, as regards newspapers, will be to diminish the cost of journals sent from one country to the other to the extent of 15 or 16 francs per annum.

PUBLIC WORKS IN FRANCE.—The demolitions, to prepare the way for a grand avenue which will form a direct line from the Théâtre Français to the new Opera House, are proceeding rapidly in the neighbourhood of the Rue

Richelieu. The new boulevard, or avenue, which is to be named either after the Empress or the great tragedian Rachel, will clear away a shabby and disreputable quarter, and let in light and air where both are much wanted. The old campanile tower, over the central entrance of the Hôtel de Ville, has been taken down, and a new one is now being erected in its place, and will shortly be finished. The conversion of the huge and irregular cavity (left by the quarries, which were worked for many years in the Buttes de Chaumont, near Belleville, to the north of Paris) into a public pleasure ground, is going on rapidly, and the works are, perhaps, the most curious of the kind that have yet been undertaken, and are well worthy of a visit. They include the formation of two lakes, with a fall of water over rocks more than 200 feet high, reproducing the famous cascade of Tivoli, at Rome, and the creation of *fac-similes* of the ancient cave of the Sibyl and of the Temple of Vesta. Standing in the midst of the lower lake, into which the water from above falls, is a natural rock, about a hundred feet high, which is being made accessible by means of two bridges, and of winding paths from the base to the summit. The progressive growth of Paris is shown by the following figures:—At the commencement of the fourteenth century there were but 310 streets in the city, and by far the greatest part of these were, in fact, narrow lanes, while all were unpaved, ill-lighted, and filthy in the extreme. During the reign of François Premier, in 1545, the number of streets, as shown by existing tax-returns, was only 427. In the time of Henri Quatre, Jacques Sanguin (the provost of the merchants) estimated them for taxing purposes, at 510, including, it is supposed, courts and alleys. At the beginning of the last century, in the reign of Louis Quatorze, when the Court of Versailles was the most splendid in the world, the Paris streets only numbered 635. In 1785, when the boundaries of the city were extended, the streets were increased to 997; and eighty years later, that is to say, 1859, they had reached to 1,433. At the present moment, and including the ancient banlieues, now encompassed by the extended boundary of the fortifications, the number of public ways, streets, courts and alleys, amounts to 2,702. A project of great national importance is now under consideration at the Hôtel de Ville, namely, the construction of a canal from Paris to Pontoise, through the Valley of Montmorency, in order to cut off the numberless sinuosities which render the navigation of the Seine extremely tedious. Pontoise is situated at the confluence of the rivers Viosne and Oise, at about nineteen miles from Paris, and has an important trade in corn, flour, and cattle. The proposed canal will debouch in the Oise, near St. Ouen l'Aumone, and join the Canal of St. Denis at Aubervilliers, near Paris; one or more small branches are included in the project, to which it is not expected any objection will be raised, and the cost of the whole work is estimated at between three and four hundred thousand pounds.

MEETING FOR THE ENSUING WEEK.

THURS...Linnæan, 8. 1. Professor Oliver, "On a New Genus of *Bignoniaceæ*." 2. Mr. Harland Coultas, "On the Law of Leaflet-genesis."
Chemical, 8. Professor Church, "On some New Cornish Minerals."

Patents.

From Commissioners of Patents Journal, October 20th

GRANTS OF PROVISIONAL PROTECTION.

Bricks—2571—V. J. B. Germaix.
Cabs, checking the payment of fares in—2029—H. A. Bonneville.
Carriages, breaks for—2561—A. R. Shaw.
Carriages propelled by manual power—2623—T. Du Boulay.
Cast steel, &c., manufacture of—2137—R. A. Brooman.
Carts, &c., breaks for—2617—T. Warburton.
Compound cylinder engines—2587—J. Howard.
Cork, cutting and shaping—2393—L. Villette.
Cotton, &c., machines for opening and cleaning—2557—E. Marsland and P. Williams.
Dishes, &c., revolving cover for—2531—C. P. Button.
Doubling machines, flyers used in—2611—M. Walker.
Electrical telegraphy—2217—R. Laming.
Fire-arms, breech-loading—2553—J. Millar and B. Burton.
Fires, apparatus for extinguishing—2559—W. H. Phillips.
Fires, apparatus for lighting and reviving of—2329—C. J. Webb.
Gas lamps—2615—J. J. Parkes.
Gun carriages—2569—G. W. Rendel.
Hair, machinery for brushing—2417—F. T. and J. H. Brandreth.
Harness for driving machinery—2619—J. Crutchett.
Hydraulic pressure engines—2445—J. Dreisorner.
Injections to the human body, administering—2555—W. R. Barker.
Iron and steel, manufacture of—2461—T. F. Cashin and J. F. Allender.
Leather—2357—L. G. Sourzac and L. Bombail.
Lucerne plant, making paper, &c., from the—2523—C. D. Abel.
Mangling and callendering—2597—R. Walmsley.
Measuring, rules for—2613—A. Nicholls.
Metallic stuffing box—1555—V. Duterne.
Nap or pile of nap or pile fabrics, cutting or shearing the—2547—W. B. Stocks, J. Whitwham, and W. Blakey.
Pianofortes—2607—G. G. Rich.
Railway carriages and locomotives—2621—M. Henry.
Railway carriages, &c., construction of—2581—H. G. Craig.
Rotary engines and pumps—2567—R. A. Brooman.
Scent and smelling bottles—2599—T. Miles.
Sewing machines—2551—M. Henry.
Sewing machines, wheel feed for—2313—J. Hose.
Spoons, forks, &c.—2397—D. J. Fleetwood.
Sulphurous acid, obtaining—2483—R. Reece.
Ventilating apparatus—2609—J. G. Woodward.
Vessels, propelling—2601—W. Clark.
Wheat, &c., grinding—2485—B. Wren.
Wooden spills—2577—T. Machin.
Wool, &c., washing—2039—J. Petrie, jun.
Writing, pens used for—2573—R. M. and D. Cameron.
Wrought iron girders—2593—J. Homan.

INVENTION WITH COMPLETE SPECIFICATION FILED.

Shirts collars and bosoms—2627—V. A. and V. J. Messinger.

PATENTS SEALED.

1110. T. Greaves and J. S. Wright.
1113. E. Wilson.
1115. A. C. Hermann.
1122. R. Canham.
1123. C. Hall.
1124. O. C. Evans.
1127. J. H. Wilson.
1130. A. Grainger & C. M. Girdler.
1141. W. E. Gedge.
1143. J. J. Parkes.
1150. T. Walker.
1153. J. N. Brown & T. D. Clare.
1154. J. N. Brown & T. D. Clare.
1157. W. Elder.
1187. T. C. March.
1189. A. C. Henderson.
1209. G. Johnson.
1225. T. H. Campbell.
1360. J. Worrall and T. Hughes.
1375. R. T. Birt.
1378. W. Eassie.
1474. C. H. Murray.
1513. W. E. Newton.
1541. W. E. Newton.
1554. A. C. Henderson.
1561. W. E. Newton.
1735. W. E. Newton.
1752. J. Calvert.
1756. J. F. Jones.
1762. S. Wright.
1785. C. F. Claus.
1787. J. F. Jones.
1843. J. Saunders and J. Piper.
1868. J. P. Wint.
1944. W. Barton.
2049. A. V. Newton.
2205. H. A. Bonneville.

From Commissioners of Patents Journal, October 24th.

PATENTS SEALED.

1168. F. D. P. J. Cabasson.
1174. W. H. Smith.
1178. H. W. Wood.
1179. S. Harvey.
1181. J. F. Feltham.
1182. R. A. Brooman.
1184. A. Grainger & C. M. Girdler.
1188. E. Moore.
1190. E. McNally.
1191. J. Bernard.
1193. R. Ferrie, J. Murray, and A. Wilson.
1195. A. Wyllie & J. McF. Gray.
1200. G. P. Dodge.
1201. W. Clark.
1202. P. A. F. Moreau.
1206. D. Y. Stewart.
1239. W. Clark.
1254. G. Peel and I. Mason.
1386. W. Davey.
1434. J. H. Johnson.
2044. W. Pouock and J. Stobo.

PATENTS ON WHICH THE STAMP DUTY OF £50 HAS BEEN PAID.

2804. H. Wickens.
2852. W. S. Gamble.
2956. M. and R. M. Merryweather, and E. Field.
2842. J. Spence.
2849. T. Greenwood.
2821. J. Clark.
2834. J. T. Cooke.
2838. G. Haseltine.
2846. H. H. and J. F. G. Kromschroeder.
2853. A. Chaplin and G. Russell.
2862. R. A. Brooman.
2888. W. J. Williams.
2979. J. H. Johnson.
2854. J. Turnbull.

PATENTS ON WHICH THE STAMP DUTY OF £100 HAS BEEN PAID.

2321. C. West.
2332. A. Allan, T. Whimster, and R. Gray.
2408. B. Foster and P. Smith.
2695. J. Tangye.